

could be made with advantage. For example, pp. 119 to 136 contain some excellent matter on pyrometers. It is advanced work. From pp. 276 to 358 we are made to wade through much that is quite elementary on conduction, convection, and radiation!

There can be no question about the merits of two important sections of the book, viz. the chapter on calorimetry and that on pyrometry. Here the author is clearly doing work which pleases him, work with which he is both theoretically and practically well acquainted, and work which is done in a manner worthy of all praise. We can recommend our engineering students and our practical engineers to obtain the book for the contents of these two chapters. Great care has been expended throughout in the preparation of the text, and although a few of the illustrations might have been improved upon, yet they are, taken on the whole, good.

As we have suggested above, the title is misleading. The engineer will expect to be able to do without any other text-book on the theory of heat engines. He will, however, require some other manual, and he will find, in consequence, much overlapping. It must be made quite clear that the contents of "Heat for Engineers" is well written. The author has evidently devoted much labour and thought to the preparation of the book. Considered individually, each chapter is excellent. The above suggestions have been made in no carping spirit, but in the earnest hope that engineers will obtain fuller benefits in the shape of a more practical text-book from one who clearly is capable of helping them to understand difficult problems.

C. A. SMITH.

HIGHWAY ENGINEERING.

Highway Engineering. By Chas. E. Morrison. Pp. v+315. (New York: J. Wiley and Sons; London: Chapman and Hall, Ltd., 1908.) Price 10s. 6d. net.

A Text-book on Roads and Pavements. By F. P. Spalding. Third edition, revised and enlarged. Pp. x+340. (Same publisher.) Price 8s. 6d. net.

THE first-named of these treatises on highways was prepared by the author, who is professor of civil engineering at Columbia University, for the students there, "with a view to furnish a text in which the fundamentals of the subject should not be buried in a mass of detail," and the endeavour has been "to outline and emphasise the basic principles which are essential to good highways."

The book is divided into ten chapters, dealing respectively with road resistance; roads made of earth, gravel, broken stone and other materials; the design of streets, and paving with stone, bricks, asphalt, and wood. It contains a great deal of useful information, especially to engineers having to deal with roads in new countries. The elementary principles of road-making are clearly set out, and copies of specifications suitable for different classes of roads are given. The illustrations are numerous and clear, and in some cases graphic, as, for example, the relative load that can be drawn with the same tractive force on different

kinds of road is shown by the number of horses required to draw the same load, this number varying from half a horse on a first-class road to ten on an earthen track.

With regard to the repairs of macadamised roads in rural districts, the author emphasises the fact, recognised by all experienced road engineers, that

"the best results are obtained at a less cost by a system of continuous small repairs, and that to keep a road in an efficient manner, incessant vigilance is required, any signs of ruts or hollows being at once filled up."

As to trees by the side of roads, the author points out that, whatever may be the disadvantages of roadside trees, it has been the practice in the most progressive road-building countries to plant trees by the roadsides. In France all roads having a width of 33 feet or over have a single row on each side, generally at distances varying from 16 to 32 feet apart. In some countries in the rural districts fruit trees are planted for which the road authority derives a revenue by the sale of the privilege to gather the fruit.

It may also be here mentioned that at the recent road conference at Paris it was agreed that, with a view to dust prevention, the planting of trees along the sides of the roads should be encouraged.

The effect of motor traffic on the surface of roads, and the great dust question, which at the present time are receiving so much attention both by the users and the road authorities, occupy only a small space in this book. The oiled roads that are in use in some districts in the United States are, however, more fully dealt with. With the object of preserving the surface of the road and preventing dust in dry weather, oiled roads are in operation over several hundreds of miles in California and other States. The cross-section of roads subjected to this process is graded to an inclination of half an inch to a foot. Before being treated with the oil the surface is sprinkled with water, then rolled with a light roller, after which a harrow having three-inch teeth is drawn over the surface. The oil is then spread from a specially designed tank cart at a rate varying from 8500 to 18,800 gallons to a mile of road 16 feet in width, or, say, from one to two gallons per square yard. Oils having an asphalt base are best suited for the purpose, but all petroleum are used. The surface of a road treated in this way is fit for the traffic twenty-four hours after being dressed, and is found to be impervious to rain-water, the surface remaining hard and firm also in hot weather.

The use of bricks for road paving, so frequently met with in Holland, has been introduced into America, especially in the smaller towns, the popularity of this form of paving being indicated by the fact that in a period of ten years, out of all the hard paving material used, 33 per cent. was of brick, 43 per cent. of asphalt, 10 per cent. of granite, and 9 per cent. of wood. The advantages claimed for bricks as a paving material are: a good foothold for the horses, efficient traction, durability under moderate

traffic, absence of noise, and ease in cleaning and repairs.

The second of the books under notice is a third edition, the first having been published in 1894. The aim of the author is

“to give a brief discussion, from an engineering standpoint, of the principles involved in highway work, and to outline the more important systems of construction, with a view to forming a text which may serve as a basis for a systematic study of the subject.”

The edition now published has been largely revised, and professes to represent the best recent practice in highway work in the United States of America.

The book is divided into eleven chapters, two of which deal with “country roads,” the information in which may be of service in our colonies and in new countries. The other chapters treat of road economics, drainage of streets and roads, macadamised roads, road foundations, brick pavements, bituminous pavements, stone and wood-block paving, and city streets. The information given is practical and useful, and covers very much the same ground as the book previously noticed. In the first chapter the author refers to statistics obtained by the Road Enquiry Office of the United States department concerning the cost of hauling farm produce to market, with the view of basing upon the figures obtained some conclusion as to the average saving resulting from the improvement of roads. The general conclusion arrived at appears to have been that, where the surface of an earth road is macadamised, the load that can be transported by the same number of horses may be doubled, if the earth road be dry and level; but where it is in a wet and rutty condition the load may be increased four- or five-fold. In many instances the economic advantage to an agricultural district may, by allowing the hauling to be distributed over the whole season, amount practically to a saving equal to nearly the entire cost of hauling by permitting the work to be done at times when other work is impossible.

With regard to the use of oil for preserving the surface of macadamised roads and for the prevention of dust, the author fully confirms all that is said in Prof. Morrison's book. The quantity of oil used, according to the author's experience, is about the same as that given by him. The results obtained by this process are deemed so satisfactory that the use of oil is largely extending.

The author refers to the use made by the French road engineers of tar, either as a surface dressing or as tar macadam for the purpose of eliminating dust. It has been found that the cost of maintenance of roads so treated is considerably reduced, the dust nuisance is minimised, and the life of the road prolonged. The quantity of tar used for dressing the surface averages about one-third of a gallon to a square yard. The application of the tar is made about once in two years. At the recent road conference held at Paris, the conclusion was arrived at that tar-spreading on the surface of macadamised roads, when properly carried out, is an effective means of

preventing dust, and that it also protects the road surface against the destructive action of traffic generally, and specially of motor-cars driven at high speeds. The tarring of the main roads, where this system has been carried out in this country, has also been found to be very effective in preventing dust.

PURE AND ANALYTICAL GEOMETRY.

(1) *Modern Geometry*. By C. Godfrey and A. W. Siddons. Pp. xvi+162. (Cambridge: University Press, 1908.) Price 4s. 6d.

(2) *The Analytical Geometry of the Conic Sections*. By the Rev. E. H. Askwith, D.D. Pp. xiv+443. (London: A. and C. Black, 1908.) Price 7s. 6d. net.

(1) **T**HIS book is an interesting introduction to the ideas and methods of modern geometry so far as required for the special examination in mathematics for the ordinary B.A. degree at Cambridge. It deals with certain properties of triangles and of groups of circles, with chapters on harmonic section, pole and polar, similitude, inversion, orthogonal projection and cross-ratios, with a glimpse at the principle of duality both in a plane and in space, but not dealing much with the properties of conics except in the interesting chapter on orthogonal projection. There is a good table of contents, and an index which is of great assistance in finding where any subject is treated.

The book contains a number of theorems, but is written largely on the heuristic principle, as in many cases proofs of theorems are left to the reader, and in some cases important theorems are to be found only among the examples; e.g. the fact that if $(AB, CD) = (AB, DC)$ the range is harmonic seems only to be given in Ex. 525 on p. 124. Such examples, which are mostly in thick type, must be treated as additional theorems.

The method of selection of theorems, especially in the early part of the book, is not easy to understand. Thus, two trigonometric properties of a triangle are given, viz. $a/\sin A = b/\sin B$, &c., and $a^2 = b^2 + c^2 - 2bc \cos A$, why is not obvious, as they are contained in any trigonometry. It seems a pity that the latter formula is not proved straight from Pythagoras instead of being merely borrowed from Euclid, Book ii. It would be much more instructive, and would illustrate the use of signs in dealing with segments of a line as discussed in the authors' first chapter.

The great charm of the book lies in its suggestiveness and in the excellent collection of examples, many of which are arranged so as to lead up to the theorems following them. The conciseness of the book will probably prevent it from being the sole text-book, but on the other hand will be of great use in fixing the student's attention on the leading theorems of the subject, and in enabling him to master them. The authors avoid any use of imaginary points, evidently thinking them unsuited for beginners.

(2) This fascinating book is the most complete text-book on the subject since the great work of Dr. Salmon. It is too difficult to be read as a first book, but for more advanced students and for a university course it is likely to be the standard book. The order in